THE

HUNTERIAN ORATION

FOR 1889.

HENRY POWER.

Hunt. Soc.

Power

£95

George Eastes Esq
with the kind regards
of the Author

THE HUNTERIAN ORATION.

DELIVERED AT THE ROYAL COLLEGE OF SURGEONS,
FEBRUARY 14TH, 1889,

BY

HENRY POWER.

LONDON.

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By common consent John Hunter is placed at the head of the English school of surgery, and has now for nearly a hundred years been justly regarded as one of the foremost of those who in any country have devoted their lives to the practice and improvement of this special branch of knowledge. He stands pre-eminent amongst the surgeons of all time for the originality and independence of his mind and for the breadth and precision of his professional attainments.

Many of his predecessors were skilful anatomists, many were excellent pathologists, many were experienced surgeons, but to a knowledge not inferior to theirs in the subjects they taught or practised, he added other, and perhaps even still higher, qualifications for the successful advancement of surgery—the gifts and faculties of an experimental physiologist. Not contented, like many who preceded him, with the mere examination and record of curious and exceptional facts and cases, which, however, he by no means neglected when they fell under his notice, he felt the full importance of the study of the common events of daily practice, and saw how much might be learnt from them. Upon these he constantly reasoned and pondered; these he discussed and endeavoured to elucidate and explain. When difficulties arose he questioned Nature with ingeniously devised experiments, and so, pursuing that method of induction, which was inculcated by Bacon and practised by Newton, as affording the best and surest means of penetrating her hidden secrets, he was enabled to establish principles which have not only received general acceptance from his successors, but have since his time constituted the very foundation of surgery, and the appli-

cation of which in practice has contributed more than the work of any other man to raise surgery from a mere handicraft to the dignity of a science.

Arago, speaking of James Watt, said that in the writings and in the models of that great inventor the germs might be found of all the improvements that have since been made in the construction of the steam engine; and so it may be said that nearly all the advances that have been made in surgery since the time of John Hunter may be found foreshadowed, or suggested, or actually adopted, in his writings, experiments, and practice.

To no other surgeon is paid the high honour we this day accord to his memory, but it is right that it should be assigned to him; for just as the intelligent pursuit of medicine dates from the time when Harvey, in whose praise an annual oration is delivered in our sister college, demonstrated the truth of his theory of the circulation, so a new era may be said to commence in surgery from the time when Hunter began to observe, to experiment, and to teach.

His career has been so often told from this place that it is unnecessary I should do more than recapitulate the leading events of his life, and this only for the purpose of reminding the younger members of the profession, and for their encouragement and example, how modestly and with how few advantages he started in life, how sedulously he worked, and how the great position to which he attained was the result of wonderfully sustained and well-applied energy and of indomitable perseverance.

Like Goethe's, his mind was many sided, and whilst some, in the long course of years that has rolled by since this festival was instituted in 1811 by Baillie and Home, have used this occasion to extol his surgical knowledge and attainments, which he himself felt to be the end and aim of all his work, others have regarded him with equal reason as a brilliant comparative anatomist, and others again have dwelt upon the services he rendered to pathology. All these aspects of his work have been well and

thoroughly illustrated, but I think it may still be instructive to consider him as an experimental physiologist, and to show the bearing his efforts in this direction had upon his practice.

He was born on the anniversary of this day, in 1728, just ten years after his brother William, at Long Calderwood, a farmhouse about eight miles from Glasgow; and as it is always interesting to see the surroundings at the commencement of life of those who have subsequently played an important part in the history of their profession, because the memories which cling to our earliest impressions insensibly but profoundly influence the mind, I made a pilgrimage last summer to see the place where he spent the first seventeen years of his life. The way to it from Blantyre lies through a straggling village and then through pleasant lanes. The house which William Hunter once said to his friend Cullen *he* would make conspicuous, though it has been really made so by its association with John, is situated on the brow of a hill in undulating country, and commands wide prospects to the north and east; and although the day was bright and clear, the wind was sharp, suggesting not so much cool and refreshing breezes, as a nipping and an eager air through many months of the year. It stands alone, and is almost, yet not completely, out of earshot of the railway whistle, and almost, yet not quite, out of view of the thousand giant stalks yielding fire and smoke from the great city to the north. It is a little removed from the roadside, with a strip of garden and some old sycamores in front, a porch with Scotch roses and honeysuckle climbing over it, and, what would have gratified Hunter's eye, house-martins building under the eaves and in the angles of the windows. On entering, a flight of deeply worn stone steps leading to the upper rooms confronts the visitor, whilst running to right and left is a narrow passage, the right opening into a parlour, the left into a kitchen. The parlour is remarkable for having a deep recess in the wall, like a berth on board ship, and was doubtless used as a sleeping apartment. The room

above it was formerly a granary. Behind the main building are various outhouses for cattle, as it is now a dairy-farm, and are evidently of recent construction.

In Hunter's time it must have been a quiet unpretending yet substantial farmhouse, with fields around it in which the lad might play and pursue the usual sports of youth, and so develop a strong and healthy frame, fitting him to bear the strain and stress of a life of incessant activity and severe mental toil. From his own account it appears that he acquired little knowledge at school, but was strongly disposed to natural history pursuits. He wanted to know about the clouds, the grasses, and why the leaves changed colour in autumn. He watched the ants, bees, birds, tadpoles, and caddis-worms. He pestered people with questions about what nobody knew or cared anything about.

At the age of seventeen he repaired to Glasgow, where he worked for three years as a cabinet maker—no bad apprenticeship for a surgeon.

In 1748 he left Glasgow, and probably excited and allured by his elder brother William Hunter's, success as an anatomical teacher, he came to London, where he at once commenced the study of anatomy and of surgery. Anatomy he pursued with diligence in his brother's dissecting-room, whilst his first introduction to surgery was under the auspices of two excellent masters, Cheselden and Pott. Cheselden, the pupil of Cowper the anatomist, and himself well versed in anatomical knowledge, was then the leading surgeon in London, and was renowned for his operation for artificial pupil, and for both his high and lateral operation for stone, his dexterity in performing the high operation being so great that according to the testimony of a French author, he in one instance effected the removal of the stone in fifty-four seconds. He was then, amongst other appointments, surgeon to the Chelsea Hospital, where Hunter attended his lectures, and he soon afterwards died (1752).

Percival Pott was surgeon to St. Bartholomew's, and

was at that time engaged in making those observations in surgery which rapidly led to success in practice, and have become classical in surgical literature. Whilst willingly conceding that by far the largest portion of Hunter's education was conducted in St. George's Hospital, where he entered as surgeon's pupil in 1754, it is a pleasure to every St. Bartholomew's man to think that some part at least of his surgical knowledge was gained in their hospital, and that he had the opportunity of seeing and of hearing that combination of sound practice conveyed in eloquent language which distinguished the lectures of Percival Pott, and which seems to have been handed down like the mantle of the prophet through Abernethy, and Lawrence, and Paget, till it now rests with graceful ease, sir, on your shoulders. At St. George's Hospital he became in due time house surgeon, continuing his dissections, and even at that early period of his career making some experiments on the blood, to which he many years afterwards referred. He now began to teach as well as to study anatomy, and devoted himself with so much assiduity to this work in William Hunter's school, and to the pursuit of comparative anatomy, that in 1758 he broke down with pneumonia and retired from London ; but an opportunity occurring in 1761 of making himself familiar with military surgery, when thirty-three years of age, he embraced it and accompanied the expedition to Belle Isle, and subsequently campaigned in Spain, from whence he returned with 200 specimens of beasts, lizards, and snakes, the foundation of the present museum. Soon after his return from Spain, in 1768, he was appointed, at the age of forty, surgeon to St. George's, and in this Hospital he died in 1793, at the age of sixty-five, from sudden failure of the heart's action.

We have no record of the precise course of study he pursued nor what books he read, but I am much mistaken if he did not guide and supplement his dissection by the then recently published 'Anatomy' of Cheselden, whilst the small volume entitled the 'Fundamenta Physiologia' of Hoffmann, published in 1746, or the translation by Samuel

Mihles of Haller's 'First Lines of Physiology,' published in 1754, would supply him with a succinct account of the chief facts that were then known in physiology.

The study of anatomy was not in those days an easy matter in any country. Accordingly, on the principle that the estimation in which any object is held is enhanced by the difficulty of obtaining it, it had been prosecuted with extraordinary ardour by a succession of remarkable men. The difficulties arose in part from the jealously guarded rights of privileged bodies like the barber surgeons, to whose censure for dissecting without permission, even so great a man as Cheselden, in the commencement of his practice, found it expedient to bow,* and partly from the repugnance of the non-professional classes both in foreign countries and in England to the examination of the human body after death, which led to surreptitious methods of obtaining subjects, and to secrecy in dissection, whilst there was complete absence of proper accommodation. This difficulty seems to have always existed. Vesalius, who 200 years before, at the age of twenty-two, revolutionised anatomy by correcting many of the errors of Galen, who was taught the whole of the then known anatomy by his master Jacobus Sylvius in three lectures, and whose anatomical plates were said to have been drawn by his friends Titian and Stephanus Calcar, had to practise dissection on the field of battle. At that time the whole of the anatomical contents of the museum of Basle consisted of one male and one female skeleton; long afterwards, one of the emperors of the Holy Roman Empire issued an edict that in Sicily, and probably at Palermo, the dead body of a malefactor should be dissected every fifth year, and that to its solemn examination the surgeons and physicians should be convoked from the whole empire.

In Austria these difficulties were still so great at the commencement of the last century that Managetta, the Professor of Anatomy in Vienna, when charged with neglect of the duties of the anatomical chair, exculpated him-

* See South's 'Memorials of the Craft of Surgery,' p. 233, Note 2.

self by declaring he had not had the opportunity of dissecting a single subject throughout the session. In France Haller narrowly escaped the galleys for conducting private dissections; and Jean Méry, who was for twenty-two years the ornament of the Hôtel Dieu, and who was one of those who most resembled Hunter in the extent and variety of his knowledge, was reduced by the prejudices of the day to steal an occasional subject from the deadhouse, and to keep it in his own bed during the day that he might dissect it at leisure by night. William Hunter himself states that no dissections were performed by students in his youth, and only one or two bodies demonstrated in a session. Dogs instead of man were used, and a fœtus was employed to show the arteries and nerves. Bromfield completed his course of lectures on anatomy and surgery in thirty-six lectures. How could surgery prosper under such disadvantages and restrictions? There was indeed one favoured spot where anatomy could be prosecuted without molestation. At Leyden, then one of the leading universities of Europe, to which, instead of the Italian Universities of Pisa, Bologna, and Padua, students flocked because permission to dissect the human body had at length been conceded by the authorities, Albinus represented anatomy—Albinus who, continuing the work of Vesalius, 1515—1564, Eustachius, 1510—1574, and of Fallopius, 1523—1562, sometimes called the creator of descriptive anatomy, whose collection of specimens was the precursor of and perhaps suggested our own museum, had just completed his splendid atlas of the anatomy of the bones and muscles, the preparations for which had been made by his own hand, whilst the beautiful plates were executed with unsurpassed fidelity by the intelligent Vandelaar. But even here the well-known and splendid painting of Tulpius by Rembrandt shows the master dissecting, the pupils only looking on. In England there had been a devoted band whose names, like those of Glisson, 1597—1677, Lower, 1631—1691, Wharton, 1610—1673, Highmore, 1632—1685, and Cowper, 1666—1709, still cling to the parts they particularly

described, and whose example stimulated the younger men to seize such opportunities as chance afforded them for the study of anatomy.

Rough and imperfect as the teaching and knowledge of anatomy was, physiology was in a still less satisfactory condition. So little was known that though courses of lectures were nominally given upon it at every university, it was clearly regarded as a subordinate subject. In England it was scarcely taught at all. At Oxford, for example, Sir Henry Acland tells me he does not believe any physiology was taught beyond what was given by the Regius Professor of Physic, and subsequently by Lee's 'Reader in Anatomy.' At Cambridge Sir George Paget informs me that physiology was probably taught by the Professor of Anatomy, the professorship in that subject having been instituted in 1707, when Rolfe was elected, who was succeeded by Morgan (1728), Cuthbert (1734), Bankes (1735), Gibson (1746), Collegnon (1753), and Harwood (1785), whose lectures certainly included physiology, as did those of Clark and Humphry. In Edinburgh, I am told by Sir William Turner, the subject of physiology was included in the Chair of Institutes of Medicine, with pathology and therapeutics. In Hunter's time it was occupied by Robert Whytt, elected 1747, and then by Cullen, Gregory, and Duncan. The Monros taught anatomy, and no doubt gave some of the facts of physiology. Whytt used Boerhaave's 'Institutions,' and Cullen and Gregory lectured alternately on each other's subject. In Dublin Dr. Aquilla Smith, the last of those daring and enthusiastic students who robbed churchyards of subjects for dissection, tells me an University Anatomist was first appointed in 1716 though lectures on anatomy had been given since 1710. The King's Professorship of the Institute of Medicine was founded in 1786. In France it was taught in the Faculty of Medicine by one of the professors taken in rotation, who each gave a few vague commentaries upon Hippocrates and Galen. In Germany, however, even at the beginning of the century, it formed a part of the courses of three

great men: of Boerhaave at Leyden, of Stahl at Berlin, and of Hoffmann at Halle. But it must have constituted a very small part of their lectures, for Boerhaave, the genial physician of Leyden, for whom the whole city illuminated her windows to express its joy at his recovery from severe illness, gave lectures also on chemistry, botany, materia medica, pathology, surgery, and ophthalmology; whilst Stahl the *homo acris et metaphysicus*, as Hoffmann styled him, delivered lectures on botany, physiology, pathology, materia medica, dietetics, and medicine, and Hoffmann as many more.

But if the number of subjects taught by such men was great, it must be remembered that the facts they could communicate were comparatively few, and those who are tempted to open their written works as a gauge of their oral instruction will find much that is irrelevant, much that is purely fanciful, many quotations from older writers, and in medicine and surgery many accounts of special cases. In this respect it is noticeable that in Hunter's lectures details are rarely given. He gives general statements and enunciates principles, but only exceptionally the cases on which his views were founded. Even after careful perusal of the writings of the older physiologists it is extremely difficult for the modern reader to see things with their eyes or to understand the language they employed. No better example could be given than the whole subject of heat, whether regarded from a physical point of view or in its manifestations in plants and animals. Its origin, being unknown, was the source of endless controversy and of the wildest theory. By some it was thought to be an elementary substance, by others only a property. It was generally taught that the body obtained its heat from the blood, which again derived it from the heart, or as one asserted, from the septum ventriculorum, whilst others derived it from a process of fermentation, and others from the meeting of bile with lymph.

Hoffmann, writing in 1735 ('Fundamenta Physiologia,' p. 107), says: "The circulation of blood is the cause of

heat in our bodies, which consist in the violent internal agitation and attrition of their sulphureous particles against the more solid parts, in consequence of which the æther is thrown into rapid hot movement," an explanation which, however obscure, has this good point about it, that it recognises heat as motion or as the outcome of motion. Nothing shows more clearly how correct views in physiology are essentially dependent upon correct notions in physics and chemistry. What could the physiologist do but wander hopelessly, when the conception generally entertained by the chemist of the process of combustion was that it consisted in the separation of phlogiston from the pure metals! It required the united and successive labours of Black, Cavendish, and Lavoisier to bring light into this darkness, and by their reliance on the balance to render chemistry one of the most exact of all the sciences. As an experimental science, physiology could not then be said to exist, but the appearance of Haller's great work was an epoch in physiology. With incredible industry he had laboured in the dissecting-room for many years, and had made innumerable experiments; with the extraordinary bibliographical knowledge which seems natural to every German, he had gathered together the opinions and the most trustworthy statements of his predecessors, and had arranged them in most orderly manner, collating and discussing their several labours and opinions and ending by the expression of his own views. Like Linnæus in botany, he made order out of chaos, and it may be fairly said that there is not a single book on physiology which does not bear the impress of his mind in its arrangement and the facts it contains. Hyrtl, with a touch of humour, says that were any living physiologist even now to be asked who was the first and greatest of physiologists, he would unhesitatingly reply, I am the man; but if asked who is the second, would as instantly answer, Haller. Like those I have just mentioned, he too seemed to know not only his own but all collateral subjects. He was a poet, a botanist, anatomist, and physiologist, as well as a physician and surgeon. He was then at Göttingen in the

prime of life. Burning with desire for knowledge, he had wandered from university to university—from Tübingen to Leyden, from Leyden to London, to Paris, to Berne, till at last he had settled down at Göttingen in the Chair of Anatomy, Botany, and Surgery, and after publishing a splendid work on the plants indigenous to Switzerland, was giving to the world his anatomical plates, his treatise on Monstrosities, his lectures on Physiology, and a multitude of memoirs on special subjects, many of them requiring much care and consideration in their production, such, for example as his well-known pamphlet directed against the views of Hamberger on the action of the Respiratory Muscles. It may be said that after Nature it was from Haller's work that Hunter drew his inspiration.

We have seen that Hunter's student career was unusually protracted for that period, for he began work in 1748 and did not complete his house surgeoncy till 1756–57, having thus been seven or eight years engaged in study, though it must be admitted that he went to Scotland for a year or more in the middle of this period. This is surely worthy of note. We have seen that the facts he had to learn in anatomy and physiology were comparatively few, whilst surgery was chiefly taught in a practical fashion, yet he took eight years to learn his profession. There can be little doubt that the central defect of our present system of education lies in the very short period at the disposal of the student for the acquirement of his professional knowledge. It is not in the multiplicity of subjects he is expected to know, for they have all a direct bearing on his future work, nor is it in the thoroughness and minute accuracy with which he has to learn many apparently unimportant facts in anatomy and physiology, in histology, in medicine, surgery and midwifery, because these collectively form the basis of his future work, and it is difficult, if not impossible, to say this will and this will not be serviceable in practice; nor is it even in cramming, because though infinitely less satisfactory than work in the dissecting-room, the laboratory, or the wards, yet even

cramming cultivates some qualities of the mind, as memory and attention. No, the real defect of our modern system is the far too brief period during which the student is expected to develop from a schoolboy into a doctor—nay, to become a *homo doctissimus*. It is not too much to say that every lad who enters the profession should have already had a fair training in chemistry, in mathematics, physics, and elementary biology, so frequently is some acquaintance with these subjects demanded in physiological research and in medical practice. Two years is not too long for the study of anatomy, histology, physiological chemistry, and physiology, and at least three years are required for clinical and practical work in the wards of a hospital.

Hunter's mind was certainly influenced to a slight degree only by the theoretical doctrines of his contemporaries and predecessors. He was indeed to some extent imbued with the "animism" of Stahl, as may be seen by a perusal of the earlier chapters of his work on the 'Principles of Surgery.' That doctrine was to the effect that the soul is a separate entity from the body, the principle of its organisation, the cause of its vital activity, that which ministers to its reparation and preservation, which presides over all the acts of nutrition, secretion, and reproduction, and over the senses. It governs the animal economy and maintains the harmony and integrity of the functions, whilst by its contest with morbific influences it produces congestion, hæmorrhages, and fevers. Stahl made physiology consist in the study of the vital phenomena considered *per se* and quite apart from the form and structure of the several organs, and of the physical and chemical actions of which they are the seat. Hence in his view the study of these subjects is secondary and subordinate to that of the mind, and he actually proposed to banish physics, chemistry, and anatomy from the study of medicine. The soul in his pious mind played the chief part in the cure of disease, and to its condition the attention of the physician should be directed. He thought that art ought not to pretend to govern nature, but should only

obey and serve it. Hence he rejected the use of quinine in fever. Hunter, too, seems to have held somewhat analogous doctrines, if we substitute the word "life" for that of "anima." He says matter may be endowed with life or deprived of it, that life appears to be something superadded to a peculiar modification of matter which is common to all animals. He compares it with magnetism, shows that it exists in the newly-hatched egg, and that therefore it is not action, and in one place goes so far as to admit that in the absorption of living parts there must be a consciousness of unfitness for remaining in the parts, and a consciousness of the absorbents of their duty to remove them. One of the last expressions of this view may be found in Alison's 'Physiology,' where the author says that "many of the phenomena exhibited by living bodies have been found to be not only inexplicable by, but manifestly inconsistent with, the mechanical and chemical laws that regulate its changes, and have been inferred from the observation of other departments of nature."

Still Hunter was little inclined to metaphysical doctrines; he was the apostle of anatomy and physiology, of structure and function in their application to surgery and medicine. These he recognised as constituting one science, united, continuous, inseparable, and saw with perfect clearness that their combined study is the only means of elucidating the nature of disease. In order to follow out these views he studied both attentively, not, indeed, with the appliances and advantages of a great laboratory, but with singular intelligence and skill. He is conspicuous amongst the small band of men who with apparently very inadequate means at their disposal obtained astonishing results—men, I mean, like Wollaston, Claude Bernard, Darwin, Pasteur, and some others, have been in the present century; men who, without much apparatus, have either revolutionised or materially improved every subject they touched. It must be remembered, indeed, that he began life when the disposition to recur to experiment for the solution of difficult questions in physics and in chemistry was familiar

to all scientific men. Black in 1754 had already instituted those experiments which showed that the mercurial thermometer was a reliable instrument of research, paving the way to his theory of latent heat. Priestley by experiment had discovered a new gas, destined to play a great part in subsequent discussions on heat and light, and on the phenomena of life. Cavendish and Watt were pursuing those researches which enabled them to determine the composition of water.

Is it surprising that a powerful and original mind should endeavour in such an atmosphere to resort to experiment for an explanation of some of the phenomena presented by the actions of living beings. He had, indeed, been preceded by Hales, whom Haller terms "vir in experiendo solertissimus," and by some experimenters in a small way, as Wintringham, whilst in Germany Haller had performed numerous experiments on animals; but, notwithstanding many facts of importance had been established, there was, as there still is, a wide field open to research, and it is only wonderful that Hunter as one of the earliest pioneers in this field of research should have gathered so few weeds and have garnered so many full ears.

In many points of view the investigator of the truths of physics and of chemistry has a far easier task than the biologist. The problems which the chemist or the physicist have to solve can be reduced to simple elements; the relations of various bodies to a standard of weight and number and to each other under the influence of various forms of force, as heat and light and electricity, can be examined separately and at perfect leisure, but the experiments of the biologist are far more difficult; everything with which he has to do is fleeting, fluctuating, unresting, under subtler influences, the several organs mutually reacting on one another. So mobile, indeed, so swiftly changing are the phenomena that the observer is apt to say with Harvey, as he watched the movements of the heart, that none but the Creator who designed could understand them.

It is sometimes said that Hunter was the first to recognise the continuity of the chain which connects man with the lowest members of the animal creation, but this is scarcely correct. It is only requisite to turn to the preface of Haller's work, with the contents of which Hunter was well acquainted, to see that this statement is inaccurate. Indeed, Haller gives a case which is precisely in point. He takes the instance of the bile, in regard to which he says disputes have arisen as to whether it is entirely formed in the liver, or whether it is, in part at least, secreted by the gall-bladder. It is difficult, if not impossible, to determine this point from the examination of the human body, but when we look from man to animals the question is settled at once, for whilst there are many animals which form very good bile without a gall-bladder, there are none which develop bile or have a gall-bladder without a liver. On these and similar grounds, he goes on to say, he has in many places introduced facts drawn from comparative anatomy.* All, therefore, that can properly be claimed for Hunter in this respect is that he was one of the first to perceive the great importance of the study of comparative anatomy as showing unity in nature, whilst he also clearly saw that an accurate knowledge of the anatomy and physiology of the healthy body was essential to the correct understanding of disease; and though, as was natural, considering the imperfect state of those branches, laying no great stress upon the application of chemistry or of the microscope to medicine, he by no means despised these aids to research, and was ever ready to avail himself of the assistance they afforded.

* F. D. Hérissant, 1714—1781, again might be mentioned as recognising the importance of a study of animals, for he presented to the astonished members of the Academy of Sciences in Paris a snail with a sprouting head, the original head, which had been abscised, being exhibited in a bottle. He discussed several subjects which at a subsequent period warmly interested Hunter, as, for example, the mechanism of the movements of respiration, the movement of the upper mandible in birds, the structure of the stomach of the cuckoo, the organs of voice, and the duration of life of toads enclosed in boxes, as well as lastly, in 1758, the diseases of bones.

The striking features of Hunter's intellect were those of all inventive minds, its penetration and its power of seizing analogies which when first pointed out appear to be far-fetched, and yet when duly weighed and considered are seen to be apt and apposite. He saw well into the kernel of things, and could strip the essential fact from the husks and surroundings which conceal it from other men. In him speculation and practice were evenly balanced. The audacity with which he theorised is sufficiently shown by his own statement that he thought at one time that if a man were to allow himself to be frozen his vitality would be preserved, and he might, after the lapse of an indefinite period, be thawed and brought back to life, so that, like Col. Fougas in 'L'Homme à l'oreille cassé,' he might deliver to a new generation the ideas and aspirations of an old one. But to correct this he had always a tendency to withdraw his ideas from the region of speculation into that of fact. It was this disposition to reduce theory into practice that made him fly instantly to experiment to explain, to verify, to support, or refute any statement. Everywhere, on all occasions, we find he resorted to and relied thoroughly upon experiment as a means of solving difficulties. At the same time he fully comprehended the obscurity, uncertainty, and doubts that surround biological experiments, and which can again only be cleared by recourse to new, well directed, and maturely considered experimental research. "The results," he says in one place, "of experiment are often quite different from what one imagines in one's own arm-chair," yet however different they may be, he fully relies upon them, and declines to acknowledge any authority but nature. The anticipation, actual observation, and interpretation of phenomena resulting from experiment may be erroneous, or conflicting results may be obtained, but such errors are to be eliminated or overcome by care and repetition, though, as he humanely observes, "no experiment should be unnecessarily repeated to prove a generally admitted fact;" or, as he elsewhere expresses himself, "when a principle has already been established by experi-

ment, the next step should be the application of that principle to useful purposes."

Let us consider for a moment how many qualities must be combined to make a good experimenter, and how far they were united in Hunter. He must possess a good general knowledge of the subject. He must know how to state the problem, and must possess ready wit to devise the mode in which it is to be attacked as well as the means to be employed in its solution, and be fertile in expedients to overcome difficulties. He must be deft of finger and neat in action, the results of constant practice in the use of instruments. He must be quick in observation, accurate and precise in noting results, distinguishing with such clear faculty as he may possess essentials from non-essentials, and, what is of still more importance, facts from inferences, yet with a mind ready to perceive the causes of variation, to recognise unexpected phenomena, and to follow collateral issues. He must be painstaking and willing to overcome failure by repetition, and think little of time, labour, or expense in the prosecution of his researches. These and perhaps others are important factors which go to the making of a good experimenter, and Hunter possessed them all in abounding measure.

That Hunter possessed a wide and general knowledge of his subject we have incontestable evidence, and his knowledge was not derived from books, or at second hand, but from direct familiarity with the chief forms of animated nature, and with the anatomy, physiology, and pathology of man. He himself ridicules the idea of an uneducated, or perhaps we should say ill-instructed person, undertaking biological investigations at all. "It happens unfortunately," he says in one place, "that those who from the nature of their education are best qualified to investigate the intricacies and improve our knowledge of the animal economy, are compelled to get their living by the practice of a profession which is constant employment;" and he adds, what can hardly be maintained in the present day, that the only educated men who have leisure are

those of the Church, "some of whom we frequently find commencing philosophy and physiology, though they have not had that kind of education which would best direct their pursuit." And in another of his sharp criticisms on his predecessors, he remarks that they were rather speculative philosophers than practical anatomists, and had been frequently misled with respect to the very facts and observations whose result was to decide the truth of their opinions. How strongly he felt that, before proceeding to experiment, a liberal education is required in kindred branches of study, is shown by his observation that "nothing in nature stands alone, but every art and science has a relation to some other art or science, and it requires a knowledge of those others, as far as this connection takes place, to enable us to become perfect in that which engages our particular attention."

He knew well that special practice and attainments, a long course of preliminary study, nay, even special gifts, are required to make a good experimenter.

"Experiments," he says in one place, "may, it is true, be made by men of leisure, but these must neither be much complicated nor have any immediate relation to those branches of knowledge with which they have had few opportunities of becoming acquainted. To look through a microscope and examine the red corpuscles of blood, to view animalculæ and give a candid account of what they see, are points on which such inquirers may be allowed to indulge themselves, but it is presumption in them to affect to reason of a science in which they can have but a very imperfect knowledge, or to expect to throw light on subjects that they have not taken the previous steps to understand."

I imagine this diatribe was directed in part against the Abbé Spallanzani, who had been writing on digestion, but chiefly against Leeuwenhoek, whose attention had been specially given to the microscopic details of muscle, nerve, plant textures, the circulation of the blood, and to Rotiferæ, but who sadly blundered when he attempted physiological

speculation, as may be seen in chapter xx of his 'Epistolæ Physiologica' (1719), where he maintains that the cause of the movement of the heart is that the blood fermenting and expanding with the heat of the heart, dilates that organ; the chordæ tendinæ suddenly then contract, and the flesh of the heart follows the same action with speed. But if this applied to the layman, it was not less applicable to the members of the medical profession, since Pitcairn could maintain that the force of the stomach was equal to 118,088 pounds; whilst others who took up the subject of digestion chemically, being little acquainted with chemistry and totally ignorant of the principles of the animal economy, erroneously explained the operation of the animal machine as exclusively subject to the laws of chemistry. The history of the conflicting views that have alternately been accepted and discarded in physiology demonstrates only too conclusively that it is not sufficient to start a question and to expect that it only needs a few experiments to settle the point.

In the next place the ingenious experimenter must place before himself some definite end and object to be attained, or some distinct problem to be solved. It is impossible to open Hunter's works at any page where he is engaged in describing experiments without being struck with the precision with which he defines his object, the adaptation of his experiment to the end in view, and the completeness, so far as the means of research at his disposal would permit, of his answer. Many examples might be given.

He is engaged in considering the circumstances which modify the velocity of the current of blood in the arteries and the quantity supplied to each part, and after pointing out with much acuteness, as Haller had done before him, the effects of divisions, of the angles at which arteries are given off from the parent trunk, and of anastomoses, he comes to consider whether an artery constitutes a cylinder or a cone, and whether when it divides, the area of its cross section is equal to, or less than, the united areas of the cross section of its branches.

The question whether the arteries were true cylinders

or cones, seems to have exercised the minds of the physiologists antecedent to Hunter, and experiments to determine the point are recorded by Haller, Senac, Keill, Cowper, and Monro.

One of the first to broach the subject was Roederer, who noticed that the umbilical arteries were wider in the cord than in the abdomen of the fœtus. Haller, however, found little or no diminution in the size of the carotid artery from the arch of the aorta to the point of division. Senac found that the thoracic aorta, the humeral, radial, and mammary arteries preserved an equal diameter throughout their course, whilst Santorini found an artery in the ostrich (probably the carotid), which runs for six inches without giving off a branch, rather smaller at the distal than at the proximal part. Haller showed that when an artery divides it becomes a little wider just above the point of division, because the sides of the parent trunk are continuous for some distance with the sides of the diverging branches. Cowper thought the arteries enlarged as they receded from the heart in the case of the middle cerebrals, the splenic, and vertebral arteries.

Keill and Monro found the spermatic artery of the boar increased in size near the testis, notwithstanding that it gives off many not inconsiderable branches to the fat around the kidneys.

Hunter goes over this ground again, and to some extent lays himself open to the charge made by his detractors, that he appropriated other men's work without acknowledgment; but in truth, like Lord Bacon, he did not disdain to light his own candle at the lamp of any other man. He first refers to the arteries of the placenta, and to the spermatic artery of the bull, both of which, he says, without branching manifestly increase in size as they pass to their termination, and form a cone, the apex of which is nearer the heart than the base, and he proceeds to ask whether this is exceptional, and subservient in these instances to some special purpose, or whether it is the case with arteries generally. Now it is not easy to measure

the area of an artery, for it may easily vary at different parts of its length, owing to the opposing action of its elastic and muscular coats, and Hunter at once adopts an ingenious device for determining the points. He selects two very long arteries that do not branch, viz. the carotids of the swan and of the camel, and fills them whilst in a horizontal position with injection. He then bores a hole of about the size of the artery through a piece of wood exactly an inch thick, and cuts off with a thin knife, after the fashion of a freezing microtome of the present day, successive segments of the arteries, which he thus obtains of exactly one inch in length. The segments he then weighed, with the result that the weights showed arteries *do* increase considerably in size as they recede from the heart; and this leads him on to consider the comparative vascular richness of the grown infant and the adult, and to a discussion on the primary cause of senility and death.

But after all it may fairly be said that the distinguishing character of all Hunter's work was not only the desire to discover truth by experiment, but rather the endeavour to apply the results of experiment to some useful purpose. The kind of research which had the strongest fascination for his mind was observation that suggested experiment to confirm, elucidate, or correct it, and then to apply the facts obtained to practice. A typical example of this is to be found in his demonstration of the muscularity of arteries, which well shows with how quick and apprehensive an intellect he was endowed; and perhaps I may be allowed to digress for a moment to note how valuable for educational purposes the history of the gradual development of knowledge now generally accepted, is, and how much may be learned from a consideration of the evidence on which it rests as compared with mere statement of facts.

The existence of a muscular coat in the arteries was thoroughly acknowledged by the older writers, Morgagni, Willis, Bidloo, Lancisi, and Monro, who named it the first or most important coat; but they seem to have all mistaken

the elastic for the muscular fibres, for they describe this coat as particularly well marked in the larger arteries, and as absent in the arteries of cold-blooded animals. Even Haller is not free from this error, though his description of these vessels contains much that may be looked for in vain in modern treatises. The idea of a muscular coat in the arteries in great measure proceeded from the theory that the arteries contracted alternately with the heart. The systole of the heart was thought to drive the blood into the arteries and to constitute their diastole characterised by the pulse, whilst during the diastole of the ventricle the arteries contract, propelling the blood by their systole through the veins into the heart, which is thus stimulated to contract. Muscular tissue is required for this purpose, and it was naturally sought for and supposed to be found in the larger arteries. They knew that ordinary muscle was fibrous, they found fibres in the aorta where they thought it ought to be, and they at once leaped to the conclusion that the aorta was muscular. Add to this that although they knew the property of elasticity, they were unaware there was a tissue specially endowed with it. The microscope was yet in its infancy. Now, if we turn to Hunter's researches on the arteries, we shall find that without the aid of the microscope he demonstrates in the most convincing way first, that whilst the arteries are highly elastic they are possessed of an additional contractile power; secondly, that the contractile power is possessed in greater degree by the smaller than by the larger arteries; thirdly, that the contractile tissue belongs to the involuntary kind of muscle; and lastly, that the fibres run essentially, if not exclusively, in the circular direction. The chain of reasoning founded upon experiment which he followed in order to prove these points was as follows:—He first satisfied himself that arteries were elastic, and that their elasticity was not indefinite, but modified by admixture with some other tissue, since at a certain point their extensibility suddenly ceased. Next he showed that they were contractile, since on section, or on

being laid bare, the lumen was completely closed, whilst their contractility was further supported by the phenomena of blushing and pallor. Then he showed that the smaller are more contractile than the larger arteries, for on injecting those of a uterus that had been removed for twenty-four hours, he found, after the lapse of another day, that the arterial trunks were much more turgid than when he left them, and as this occurred forty-eight hours after death it could not be referable to voluntary but to involuntary muscle, which retains its contractibility so much longer than the voluntary; and he proceeded to experiment on a human umbilical cord, with a view of seeing how long the contractile power was preserved, and found it to be two days. Lastly, he proceeded to stretch portions of artery, both longitudinally and transversely, and showed that the muscular tissue acts chiefly in the circular direction by the difference between the first measurements and the size the artery returns to after stretching. I need not stay to point out how all these facts tended to direct his mind to the surgical treatment of aneurysm.

Wherever it is possible he examines the point to be determined with the greatest care in its physical aspect before proceeding to the determination of function. Thus, —he wishes to know how and why a bee stings. He proceeds first to make a careful dissection, examines the parts and describes them accurately, so accurately indeed that he is able to distinguish two secretions, a clear and an opaque one, which he believes to be ejected simultaneously when the animal stings. He dips a needle into each and pricks himself on the hand, and finds the clear secretion causes soreness and inflammation, the other does not. He desires to know the uses of the seminal sac of the female moth. He accordingly again carefully dissects out all the parts, both in male and female, isolates a female, and when she begins to lay her eggs impregnates them artificially with the semen of the male, some of which was taken directly from the male, and some from the seminal receptacle of the female, and proves its uses incontestably.

Of the deftness of finger, the dexterity of manipulation, the *manus oculatus*, as Bonetus terms it, he possessed, little need be said. The museum proves that he possessed it in perfection, and such specimens as those I now show might be pitted, for delicacy of dissection, against those of any other anatomist. Besides the numerous pieces of dissection we possess, the museum of the University of Glasgow contains many preparations, which, under the name of Dr. Hunter's Museum, are kept apart, and which were in some instances certainly, and in others probably, made by Dr. Hunter himself. Many of these have resisted the destructive influence of time, and of a double removal, in a remarkable manner, and specimens of the testes, of the kidneys, and of the lymphatics, beautifully injected with mercury, may be seen, as perfect as if they had only been made yesterday. There are others which suggest strongly that they were the work of John Hunter, as for example, one showing the calcareous plates in the stomach of a lobster. put up to prove that teeth need not necessarily be in the mouth ; others of teeth stained with madder from the pig, showing that the arteries convey the colouring matter of madder to the teeth as to other bones, but whilst it is gradually removed from other bones it remains in the teeth, as if they had no absorbents ; and again, other teeth with beautifully injected periodontal membrane, with many specimens illustrative of comparative anatomy. No doubt some, or even the majority, of these may have been suggested by William Hunter and executed by Hewson, who we know was trained for this very work, but it is highly probable that many of them were put up by John Hunter ; at all events he must have studied them carefully, for they are either often referred to or form the texts of his discourses. He notices that coolness and accuracy are required in experiments on living animals.

Of his acuteness and readiness to follow out collateral issues many examples might be given. I will mention one only, which illustrates also his critical faculty. He is discussing digestion, which naturally leads him to

dwell on the formation of acid (the result, he thinks, of fermentation), which he notices is frequently developed in large quantities in disease; and this again suggests to him the question of the origin of the air that is sometimes formed in the stomach, and he asks whether it may not be the result of a kind of secretion, for although it might proceed from the decomposition of the food, yet—and here his general knowledge appears—it sometimes is generated in other cavities, where no secondary cause can be assigned, as for example, in the uterus and vagina, in the deep tissues soon after gunshot wounds, in the air-bladder of fishes, and in the intestines of some other animals, all of which point to the secretion of air by the membrane from the blood. This leads him on to question the excretion of air by the skin. Just previously two papers had appeared maintaining the occurrence of this excretion, one by Dr. Ingenhousz, the other by Count de Milly, in both of which the observation was recorded, though it must often have been noticed before, that air appears on the surface of the skin on plunging the body, or any part of it even, into cold water, and even when precautions are taken to prevent the entrance of air. Hunter at once seizes the weak point of this theory, exposes it, and starts off in the career of experiment. There is a circumstance, he says, the Doctor did not attend to at the time, which I imagine renders his experiments very fallacious, for he did not consider that water for the most part contains a great deal of air; therefore the globules of air might as readily come from the water as from the body, which makes it necessary to ascertain by experiment from whence the air comes which is attached to the body when immersed in water. Experiment shows him that water takes up air in proportion to its coldness; hence the water round the skin, being warmed, parts with some of its air, which adheres to the skin. He finds iron at 150° F. plunged into water at 70° F. has the same effect as the skin, whilst iron at 80° F. causes little or no separation of air, and so on.

Another example of his readiness to seize and to follow

up any line of research that opened up unexpectedly in the course of a totally different subject, or even from a particular occurrence, is his action on Mr. A. King's casual observation in 1776 that the combs of his cocks were unusually smooth and small. He asks the reason, and is told that they were frost-bitten during the hard frost of the preceding winter, an answer that would have sufficed for most men, or have led them only to consider the effects of cold; but with Hunter it was otherwise, for it led him to examine carefully how the comb could be frozen, the influence of such freezing on the circulation, and the effects of freezing mixtures on fish and on earthworms, and he was especially interested in this because a paper had recently appeared by Blagden on the resistance of man to variations of temperature. But I have said enough to show how acute his mind was, how readily his interest was excited by collateral issues, apparently only distantly connected with the subject in hand, and how instantly his ideas ran to experiment for the solution of a difficult point.

Lastly, the able experimenter must be painstaking, and sparing neither of time nor expense. The evidence of Hunter's fitness for experiment on these grounds lies on the surface, for every paper and memoir affords incontestable evidence of the prodigious expenditure of time, money, and labour he bestowed on his experiments, and he everywhere shows his full appreciation of the necessity for this, and his feeling of the doubtfulness of one or two isolated experiments. Thus in his experiments on bees he says he killed several hives, and examined every single bee, to assure himself that no male was left after the fertilisation of the queen bee had been effected. Now the number of labourers in a hive amounts to at least four thousand, so that he must have examined ten or fifteen thousand bees one by one to determine this point alone. In another place he speaks of the injection of various substances into the veins, and remarks that before any man pretends to determine what will kill he ought to have killed at least a thousand animals, adding, in reference to the case of Captain

Donellan, a "poor devil was lately hanged at Warwick upon no other testimony than that of physical men, whose first experiments were made upon this occasion." In his experiments on plants and animals we are astonished at the number and variety of the subjects of his experiments. That he spared no expense in the pursuit of his observations and experiments is shown by his commissioning a surgeon to go to the North Pole to obtain specimens of whales, and by the vast sums he must have expended in procuring dogs, sheep, and other animals for his purposes.

Hunter's special gifts as an experimenter are well shown in his researches upon the heat of plants. This if not absolutely novel inquiry had not been made the subject of any well-considered experiments, and is indeed passed over in a very few lines even in the most recent works on vegetable physiology, but Hunter had fully comprehended the bearing of such an inquiry on the theory of life. Plants and animals are, he clearly saw, linked together by innumerable ties, and however different their organisation may be, they exhibit many phenomena in common, and amongst these it would, he thought, be interesting to know whether they could produce or generate heat in the same way, though perhaps not to the same degree, as animals. To determine the question he at once betook himself to experiment, and his account of the method he pursued is not uninteresting to follow. An ordinary observer wishing to ascertain the heat of a tree might, I imagine, think it necessary only to apply a thermometer to the surface, or to lay it in a groove, or still better insert it into a hole made at any part of the first tree at hand, but Hunter proceeded in a more thoughtful fashion. In the first place he casts about for the kind of tree most appropriate for his purpose, and selects a walnut, probably because he knew it was a fair representative of an actively growing succulent plant. He then selects a spot at the height of five feet from the ground, that it may not be influenced by the temperature of the soil. He bores a hole to near

the centre on the north side, that the disturbing effects of the sun's rays may not be felt. The hole he directs to be very small, and to be made with a gimlet, and it must slope upwards that the sap may flow away. Then time must be allowed to elapse between the boring and the insertion of the thermometer, that the heat caused by the friction may have had time to dissipate, though, as he is careful to observe, this must have been extremely small, since in his case the gimlet was not perceptibly heated. The stem of the thermometer should be fine and delicate, and must be protected by a covering of wool to avoid the influence of the external air. When all these arrangements have been made and completed, still the temperature must be taken at different times of the day and on many occasions, and at different seasons, and, it need scarcely be added, on different trees.

The question of animal heat seems to have been one of special interest for Hunter from an early period of his career. He wished to ascertain its degree, its mode of generation, and the means by which it was preserved and lost. In his letters to Jenner he returns to the subject over and over again. He begs him to ascertain the heat of bats, and gives him very precise directions as to the method in which it should be ascertained, telling him to make a small hole in the belly, and to thrust the bulb of the thermometer up to the diaphragm and down to the pelvis, a proceeding the importance of which has been clearly demonstrated by Claude Bernard. He repeated his wishes in regard to hedgehogs. It is probable that his interest in the subject of animal heat was reawakened by the papers of Cavendish, published in the 'Philosophical Transactions' for 1783, 1786, and 1788.

He himself paid particular attention to that of man, and it is interesting to notice that the determination for man is precisely that given by one of the best and most recent authorities on the subject, M. Richet: 37° C., 98·6° F. This is remarkable when we consider that he had not at his disposal the delicate instruments of the present day, and he probably failed to notice the action of some of those condi-

tions which Davy and subsequent observers have shown exert so much influence upon it; nor did he, like Jürgensen, take the rectal temperature of several persons for three days every five minutes, nor, like Ogle, extend his experiment three times each day for a year ; yet, as we have seen, the outcome of his work, although a considerable interval separates the highest from the lowest number, has received general acceptance, whilst he was far in advance of his time in noting the effects of sleep and of hybernation. In his experiments on the resistance of animals to cooling, or their power of maintaining heat, which is but a short paper, he notices that with artificial cold animals die before they are frozen, whilst in cold climates they do not. He points out that whilst the extremities vary much more than the central parts, yet that they undergo changes of temperature under exposure to different degrees of heat much less quickly than inanimate bodies, and never to the same extent. Like every good experimenter, he noticed imperfections in his means of observation and instruments, and sought to improve them, making, for example, the bulbs of his thermometers smaller, and taking care that their stems were more slender with a finer bore, and was at once rewarded by finding greater exactness in his results.

He made, finally, a practical application of his experimental research by showing that since the body possesses what we now call a power of regulating its own temperature, if the full effects of a large bath are to be obtained, the patient should move about from place to place in it, that the layer of water in contact with the skin may undergo frequent change, or if the bath be small, a constant current should be maintained, since the living body can both reduce the temperature of the surrounding medium when it is hotter, and raise it when colder.

If we now turn to the surgical work done by Hunter, we must in the first instance examine his writings.

Hunter's 'Lectures on the Principles of Surgery' were really the first philosophical exposition of surgery that

was published in England. If we wish to compare it with other treatises, with the exception of Wiseman, we are compelled to select those of contemporary foreign surgeons, those, for example, of Heister and Paré, with both of which it contrasts favorably in the largeness and comprehensiveness of its views. Yet both these had passed through very similar experiences to those of Hunter. Heister was in the height of his practice in 1750, when Hunter was just beginning his professional career. Like Hunter, he had devoted great attention in the earlier part of his life to anatomy, and subsequently betook himself to the wars in Flanders. In the sharp actions that occurred at the sieges of Lisle, and at Oudenarde, Wynenburg, Tournay, and Mons, he learned the practice of his profession, and on returning home, finding, as he says, that there was no general treatise in the German language, and that the generality of the surgeons of that day were content with being able to cure a slight wound, open a vein or an abscess, or at most to set a fracture and reduce a dislocation, whilst they left those disorders and operations which require the greatest skill to the management of daring quacks and itinerant operators, with which Germany at that time swarmed, he wrote his book, and an excellent work it still remains.

I do not mean to say that Hunter's 'Principles' are as complete as Heister's 'Surgery' in some points of view. He says nothing, for example, about bandaging; he does not describe the appropriate manipulation for bleeding, for the setting of fractures or for the reduction of dislocations, nor even for amputation, details which take up many pages in the foreign works. All such matters he probably thought were, or might be, learnt by the diligent student, not in books, but in the wards of a hospital, or in the room of the patient; but he takes infinite pains to show that bones are liable to similar diseases to soft parts; that though hard, they are liable to inflammation and its consequences, to caries, to ulceration, induration, and death; to explain by what means union is effected, how the modelling pro-

cess is accomplished, what length of time is required for repair, and how false joints arise, all points be it observed resting upon observations on man and experiments in animals.

It would, perhaps, hardly be fair to take the whole subject of venereal diseases for comparison with the accounts given by other masters of the craft, because Hunter made them a special subject of inquiry and devoted great labour and time to elucidating the phenomena presented by them, whilst Heister, for example, only notices them as a part of surgery in general; but Hunter's account is undoubtedly superior to many that appeared after his time.

Hunter's high position as a surgeon rested in part on his well-known knowledge of anatomy and physiology, but in great measure on his thorough practical knowledge of surgery, derived in part from his military experience, and in part from his opportunities as a hospital surgeon and a man in large practice. Theory is excellent, but in such an art as surgery practice is essential. Haller in one of his writings observes that he had taught surgery *ex cathedrâ* for seventeen years, and although he had frequently demonstrated most difficult operations on the dead body he had never once made an incision into a living man, as it would have been too trying for his nerves. Imagine the difference between a man demonstrating tracheotomy, or ligature of the subclavian, or hernia, on a dissecting table, and the same operation conducted in the living subject, with all the concomitants of turgid veins, dyspnœa, and imminent suffocation, or death from hæmorrhage. The demonstrations *ex cathedrâ* may have been good and useful, but they cannot supply the place of actual practice, any more than a man can learn anatomy from plates.

It is not surprising that surgery exactly suited his mind, for every accident was to him a study, every injury an experiment. He bleeds a woman in an apoplectic fit from the temporal artery, and notices that when she breathes freely the blood became red, when with difficulty or not at all, dark. Yet, he adds significantly, all this made but

little alteration in the pulse; and he records in the same section other cases and other experiments which were all only an extension of experiments made a quarter of a century previously, when he was house surgeon at St. George's. He even regards his own case as one of an experimental nature. He reasons upon his own ailments, as, for example, on the cause which induced his spasms, and shows how certain mental conditions connected with expectation, such as fearing to miss the swarming of his bees, or that he should be in time to get a gun to kill a cat that was watching his pheasants, would bring them on, whilst more intense mental pre-occupation was without effect.

I said Hunter's work would contrast favorably with either Heister's or Paré's, and it differs from them in the wider basis on which it rests. For example, in neither of them do we find that the authors considered it requisite to begin with any general account of the structure and functions of the body at large. Hunter, on the contrary, begins by declaring he has no intention to write a regular and complete treatise, but rather to give the principles on which all surgical treatment should rest, and this is impossible without a general knowledge of the animal functions. Hence we find a chapter devoted to the nature of life, another giving his general views on organisation and action, another on the heat of animals, and so on, all subjects that are passed by as wholly foreign to pure surgery by Heister and by Paré. In fact, of the twenty-three chapters into which his 'Lectures on the Principles of Surgery' are divided, no less than thirteen are devoted to general principles.

As in his physiological so in his surgical observations and inquiries, he everywhere preserves an open mind—a mind ready to receive new ideas and suggestions, and to deviate, upon sufficient cause being shown, from established practice. There is no surer trait of a strong, self-reliant, and independent mind than this. Few things are more binding than routine; it saves the trouble of thinking, it takes away the sense of responsibility; we follow the usual

custom, and no blame attaches to us if failure results, for others would have done the same. In Hunter's time wounds of large joints were almost invariably directed to be amputated, but in his reflections on the subject he raises exceptions : thinks, indeed, that removal of the limb may often be required, but concludes with the maxim which would be accepted by every conservative surgeon of the present day, but was then novel, that all wounds of the joints should be healed, if possible, by the first intention.

In a section on fracture of the patella, we may see in the briefest possible compass the secret of Hunter's practice and of his success in practice. He says that he went with a friend to pass a day or two in the country. The lady of the house had broken her patella several years previously, and had become totally unable to walk, since the surgeons, following the practice of the time, had done nothing except employ passive motion, seating her upon a table and swinging the leg to and fro. Hunter tells us he spent a whole night in reflecting on her case, and considering that all muscles were capable of contracting a little more than the joints over which they passed permitted, he thought that, however shortened the rectus had become, there was still a further power of contraction which might by practice be brought under the power of the mind, and which might be further aided by interstitial absorption. He therefore recommended her to exercise her limb as often as she could for a month, assuring her that if after the end of that time she had acquired the least power of moving the limb voluntarily she would surely regain the power of walking ; and the event proved his forecast in the happiest way. In the report of this case we find as in a nutshell the whole of Hunter's practice laid before us. His instant interest in the case, his profound and thoughtful consideration of the causes of trouble, his supreme reliance on the efforts of nature, his recognition of the appropriate intervention of art in placing nature under the most favorable condition, are all well brought out in the short record of this interesting case.

If Hunter were now to return to life he would see vast improvements on all sides. He would find a profession fairly united, the two Colleges working harmoniously together, with the attention of their members increasingly directed, as time rolls on, towards the prevention as well as the cure of disease. He would hail with special delight in this respect the experiments and researches of Sir Joseph Lister; for though we may cast aside this or that particular form of dressing or antiseptic, the cardinal fact upon which he has insisted, of attention to cleanliness, is admitted by all. He would rejoice in the widening of our horizon, opened up by the application of the microscope and by a better knowledge of chemistry, and by the more accurate investigation of disease, owing to the introduction of the stethoscope, ophthalmoscope, and thermometer into practice; and he would, I think, be lost in amazement at the minute and numerous details now considered to be requisite for the satisfactory description of any well-observed case. I can conceive nothing that would be a source of greater satisfaction to Hunter, if he could once more stand amongst us, than to enter the doors of this building, and see the still extending and still developing outcome of his energy and scientific spirit.

The Council of this College has been sometimes reproached with lack of energy, with an indisposition to advance with the times and to aid original investigation, just at it has been more recently charged with lavish expenditure. I think it has kept the middle path, and I venture to think if Hunter could indeed return he would make no such criticism, and would be well satisfied with the mode in which the trust confided to that Council has been carried out. He would see a splendid museum and a splendid library, a library which Mr. Bailey, with all his energy and ability, is striving to make the most complete as well as the most comfortable in the world, and its contents the most accessible. He would see with surprise and admiration the additions that had been made to his own collection in Anatomy, Comparative Anatomy, and in Pathology,

by Clift, Owen, Quekett, Flower, and last though not least, by Professor Stewart. He might during the past two years have heard from the foremost of English pathologists and philosophical surgeons lectures on Cancer, and a series of lectures by Sutton, Cheyne, Bowlby, Lockwood, Barker, Bryant, Jessop, and Gunn, on Pathology, Physiology, Embryology, and Surgery, every one of which I believe he would have attended and profited by. He would be led through the new rooms devoted to research which will soon be fitted with all the requirements of the best appointed laboratories, and where every assistance that money, skill, and experience can give will be afforded to those who are willing to give up their time and apply their talents to the advancement of medical and surgical knowledge, whilst there would be one to whom he would turn with grateful thanks for his efforts in preserving, naming, classifying, and adding to the pathological department, and who, though not formally installed as Curator in the College books, has fulfilled all the functions that pertain to that office in so efficient a manner as to place that department in our Museum at the head of all others in this country or abroad,—Sir James Paget.

One of the greatest of our English kings in dying directed that his bones should be borne aloft at the head of his army, that they might carry with them the prestige of former victories, encouraging the hearts of his ancient followers, and striking terror into those of his enemies. The true remains of Hunter do not rest in Westminster Abbey, where he lies surrounded by the best and noblest of England's sons, but in his writings, his practice, and in the museum around us. Let their study put to flight our enemy ignorance, which is darkness, and lead us to light, which is knowledge.

PRINTED BY ADLARD AND SON, BARTHOLOMEW CLOSE.